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ABSTRACT

This proposed study will examine the underlying causalities of the U-shaped developmental trend in metaphoric production and the causes which make up the linearly increasing trend. Seven hypotheses will be tested in the study. Ninety children, all from middle-class families and attending nursery and public schools in Austin (Texas), with ages ranging from 3-14 years, will participate as subjects. Children will participate in three tasks regarding metaphoric production, two knowing-level tasks, and the Peabody Picture Vocabulary Test. Metaphoric figures will be rated by trained judges and the number of figures transformed into proportion. The model predicts the relationship between metaphoric production, age, and vocabulary capacity. The proposed study argues that knowing-level is the underlying causality for the U-shaped curve and that age is a covariate with knowing-level. Further studies are suggested for creating a better method for encoding the individual's novel and frozen metaphors, employing a cross-cultural design, investigating the U-shaped developmental curve in other creative fields and in subjects who are deficient in some major fields, and exploring the relationship between knowing-level two and metalinguistic abilities in regard to the relationship between linguistic and cognitive development. (One table of data and five figures are included. Forty-nine references are attached.) (MG)

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THE DEVELOPMENTAL TRENDS IN METAPHORIC PRODUCTION: THE ROLES OF KNOWING-LEVEL AND VOCABULARY CAPACITY

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Abstract

Metaphorical language plays an important role in exploring the nature of language and thought. Focusing on the developmental trends of metaphoric production, the present proposal employs Bickhard and Campbell's knowing-level model to reconcile the controversies in literatures.

The present proposal suggests that there are two kinds of underlying processes for metaphoric production, and that there are also two kinds of developmental trends in metaphoric production. In exploring the developmental trends in metaphoric production, two kinds of metaphors, undifferentiated and category-violation metaphors, are the kinds considered. In a naturalistic situation, the developmental trend in metaphoric production is U-shaped curve, and given that the encouragement is provided, the developmental trend is a linearly increasing one. Six hypotheses related to the U-shaped curve and one related to the linearly increasing trend are constructed. For the U-shaped developmental trend, the present study argues that knowing-level and vocabulary capacity are two variables which cause the U-shaped developmental trend in metaphoric production. In addition, vocabulary capacity only explains the first two stages of the U-shaped curve. For the purpose of discussing the complete relationship between vocabulary capacity and the U-shaped curve, there are interaction effects between vocabulary capacity and knowing-level on metaphoric production. As for the linear increasing

trend, motivation is not the only factor which contributes to the task-specific effects. The present study controls the motivational factor and explores the interaction effect between the task difficulty and knowing-level.

Ninety children with ages ranging 3 through 14 years old participate in three tasks regarding metaphoric production, two knowing-level tasks, and the Peabody Picture Vocabulary Test. Metaphoric figures are rated by trained judges, and the number of figures is transformed into proportion. The linear model analysis is employed to reveal the relationship between age and metaphoric production, the relationship between knowing-level and metaphoric production, the unique contribution of knowing-level to the U-shaped curve in metaphoric production, and the interaction effect between vocabulary capacity and knowing-level on metaphoric production. The question whether knowing-level and vocabulary capacity are the only two variables causing the U-shaped curve is answered. The planned comparison analysis is employed to indicate the interaction effect between knowing-level and task difficulty on metaphoric production.

The correlation between knowing-level and age, the criteria for judging novel and frozen metaphors, the index for vocabulary capacity and the difficulty to decompose the effect of motivation and of task difficulty in a difficult task situation are discussed in the last section. Furthermore, the theoretical and practical implications of the present study are indicated, and some further studies are suggested.

INTRODUCTION

Along with its aesthetic value in literature, metaphorical language has played important roles in other fields. On the one hand, metaphorical language serves as a heuristic aid in learning and teaching (Ortony, 1975; Petrie, 1979), in problem solving (Pollio et. al., 1977), and in the development of science (Boyd, 1979). On the other hand, and most importantly, but quite overlooked in the traditional sense, metaphorical language contributes to exploring the nature of language and thought. A growing body of research has revealed that there are no distinct boundaries between literal and metaphoric language (e.g. Rumelhart, 1979; Sadock,1979). Lakoff and Johnson (1980), furthermore, claimed that most of our normal conceptual system is metaphorically structured; that is, most concepts are partially understood in terms of other concepts. Accordingly, theories of language and of cognition are incomplete if they do not handle the phenomenon of metaphor, and they are inadequate if they cannot.

Based on the interest in metaphorical language, the purposes of this study are to investigate the developmental trends of metaphoric production and the underlying causality concerning the trends. To these ends, the empirical evidence of the developmental trends in metaphoric production will be depicted first. For reconciling the empirical controversies, the definition and nature of metaphor and the variety of experimental tasks will be discussed second. Finally, possible factors, such as knowing levels, vocabulary capacity and

motivation to make up metaphors will be considered to explain the developmental trends of metaphoric production.

In reviewing the literature regarding metaphoric production, two kinds of developmental trends, in general, have been found (e.g., Pollio and Pollio, 1974; Gardner, 1975). They are the U-shaped curve trend and the linearly increasing trend. In the relatively naturalistic experimental tasks, the U-shaped curve is considered to be the developmental trend in metaphoric production. However, if subjects are encouraged to have metaphoric usage or the task is too difficult for very young children, then the developmental trend will be the linearly increasing one. In discussing the U-shaped developmental trend, age is considered to be only a covariate of the underlying causality of the U-shaped developmental trend. In the model presented here, inexpressibility and children's concept of "no rules" are underlying causalities for very young children's metaphoric production; obeying rules is taken to account for the literal stage in developmental trend; and children's coming to know that rules can be changed explains why preadolescents' metaphoric expression increases again. The issues of the nature of metaphor, the difficulty of the task and children's concepts about "rules" are all related to the knowing-level model (Bickhard, 1978; Campbell & Bickhard, 1986). Hence, the present study will deal with children's knowing-level to see if the knowing-level is a better predictor than age for the U-shaped curve in metaphoric production, to see the interaction between children's vocabulary capacity and knowing-level on metaphoric production, and to examine the relationship between task difficulty and knowing-level on metaphoric production.

Literature Review

For the purpose of exploring the development of metaphoric production, some empirical evidence will be lumped together to know what the age trend looks like. Factors concerning the developmental trend, such as the nature and definition of metaphor, measuring tasks, and the underlying causality for the trend, will be discussed in order.

I. Developmental trends in metaphoric production

Pollio and Pollio (1974) conducted a study in which students ranged from 8 to 10 years participated in three metaphoric production tasks--*composition*, *multiple sentences*, and *comparison*. In the *composition* task, children wrote a composition on one of five imaginative topics; in the *multiple sentences* task, children wrote as many sentences as they could from sets of five different double-function words; and in the *comparison* task, children made comparisons between sets of three different pairs of words. The results showed that there was a relative decrease in the number of figures produced in the *composition* task over successive ages rather than in the other two tasks. The age trends in metaphoric production can be depicted as Figure 1.

Gardner, et al. (1975) conducted an experiment by asking subjects to produce the ending of three forms of eighteen stories. Examples of the three forms of tasks are:

Form S -- He looks as gigantic as... (isolated sentence)

Form N -- We're glad to have you at this party for our son. Look at that boy standing over there. He looks as gigantic as... (neutral context)

Form M -- Things don't have to be huge in size to look that way. Look at that boy standing there. He looks as gigantic as... (facilitating context)

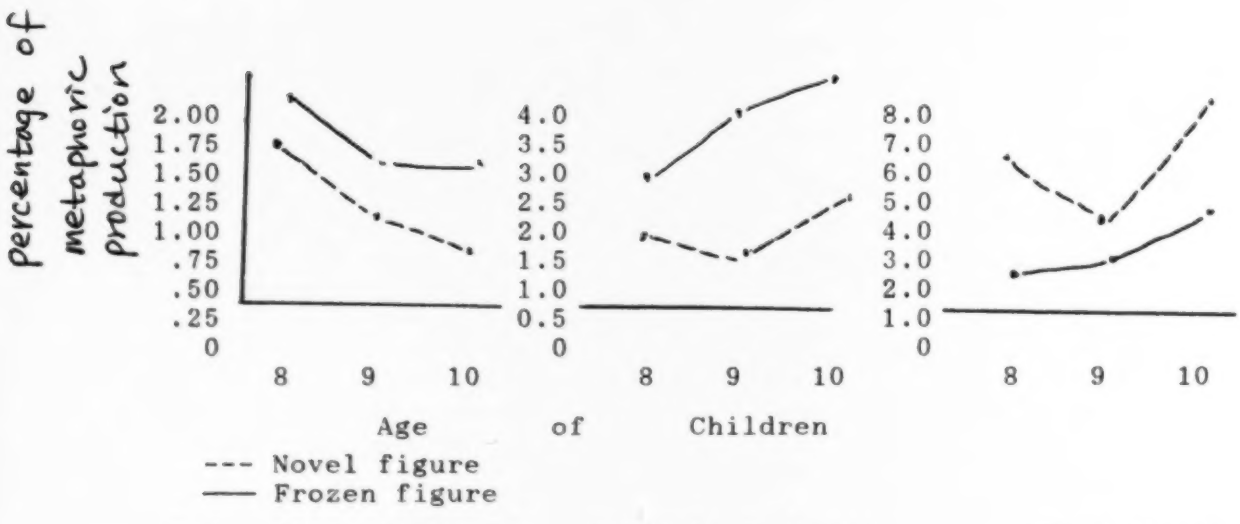


Figure 1. Developmental trends of metaphoric production in Pollio and Pollio's (1974) study.

Subjects in five age levels (3-4, 7, 11, 14, 19 years) participated in this study. Since the results from the three forms of tasks were almost identical, the data were combined and revealed that the youngest children formed the highest percentage in appropriate metaphors (novel metaphor) and, except for the youngest group, there was a slow but steady increase with age in the number of appropriate

metaphors. However, there was no significant difference across the five groups because of the large individual variation within the youngest group. The developmental trend in novel metaphoric production is shown in Figure 2.

Figure 2. Developmental trend of novel metaphoric production in Gardner et al.'s (1975) study.

Concerning the development in metaphoric production, Pollio and Pickens (1980) asked subjects, provided with topics and a set of cued questions, to produce compositions. Subjects were students in 3rd, 5th, 6th, 11th grade with age ranged from 8 to 17 years. The results suggested, on the one hand, that frozen production decreases from grade 3 through 6 and then increases sharply from grade 7 through 11; on the other hand, that novel production decreases slowly from grade 3 through 11. Those developmental trends can be depicted as showed in Figure 3.

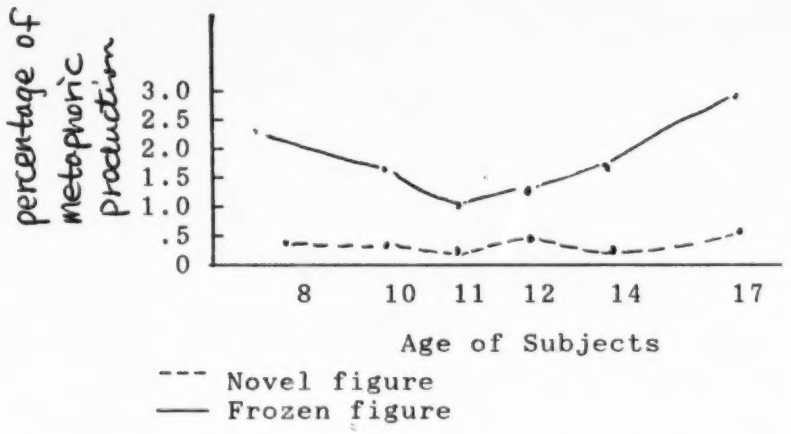
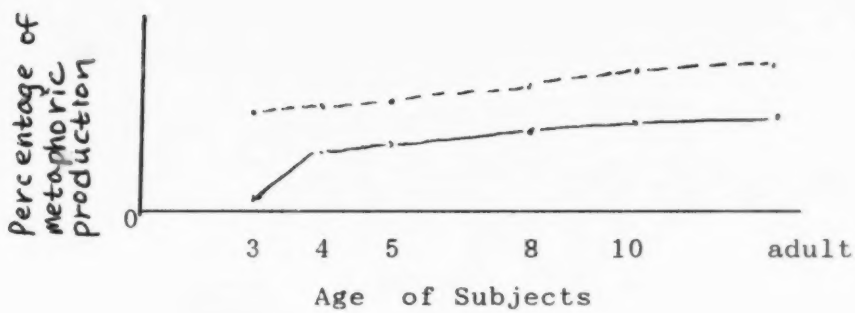


Figure 3. Developmental trends of metaphoric production in Pollio and Pickens' (1980) study.

Winner, McCarthy, and Gardner's (1980) experimental study asked subjects who were in six age levels (3, 4, 5, 8, 10 years, and adults) to provide a pretend name for each series of objects in each of three tasks -- *subject enactive*, *perceptual renaming*, and *experimenter enactive* condition. In the *subject enactive* condition, subjects were allowed to manipulate the object prior to providing a new name; in the *perceptual renaming* condition, no manipulation of the objects was allowed -- subjects were required to simply look at the object held by the experimenter and give it a pretend name; in the *experimenter enactive* condition, subjects were not permitted to act on the object, but were allowed to watch the experimenter manipulate the objects in such a way as to suggest a pretend identity. The results indicated that the *experimenter enactive* task was relatively easy for all ages, whereas performance under the other two conditions was relatively low for 3-year-olds and improved with age. Since there was no graph concerning these results in Winner, McCarthy, and Gardner's study, the figure of the developmental trends in this study will be simplified as displayed in Figure 4.



--- experimenter enactive condition
—— subject enactive or perceptual renaming condition

Figure 4. Developmental trends of metaphoric production in Winner, McCarthy, and Gardner's (1980) experimental study.

Billow (1981) observed children's spontaneous metaphors when they were playing. Children from age of 2:7-3:6 to 5:7-6:0 were observed for one or two half-hour periods of free play. Naturally occurring utterances in unconventional uses were recorded. The results revealed that the data fell into a pattern of decline with age, though overall they do not reach statistic significance in difference. Compared with the oldest group, the youngest group is most likely to produce more metaphors than the oldest. The developmental trend follows the pattern shown in Figure 5.

Figure 5. Developmental trend of metaphoric production in Billow's (1981) study.

The foregoing literatures indicated that very young children could produce metaphors (as young as age 2 in Winner, McCarthy, & Gardner's study), and different developmental trends were revealed. On the one hand, the data showed that the youngest children (from 2- to 4-year-olds) produced the highest percentage of metaphors (Billow, 1981; Gardner, et al., 1975); after 4 years old, children's metaphoric production decreased with age (Billow, 1981; Gardner, et al., 1975; Pollio & Pickens, 1980; Pollio & Pollio, 1974, *composition* task); and up to preadolescence (about 10 or 11 years old), children's metaphoric production increased with age again (Gardner, Kircher, Winner, & Perkins, 1975). The developmental trend, in principle, was a U-shaped curve. On the other hand, Winner, McCarthy and Gardner (1980) found that during 2:7 to 6:0 years old, children's metaphoric production increased with age; likewise, Pollio and Pollio (1974) reported that in the *multiple sentences* and *comparison* tasks, children produced more metaphors across the age of

8 to 10. It seems that children's capacity in producing metaphor has a positive linear relation with age. The developmental trend thus is a linearly increasing trend.

For interpreting such different developmental trends in metaphoric production, researchers have proposed two main kinds of reasons. Pollio and Pickens (1980), Pollio and Pollio (1974), Winner, McCarthy, and Gardner (1980), and Marschark and Nall (1985) claimed that there were task-specific effects on those empirical studies. Vosniadou (1987) argued, given that children's metaphors are real metaphors, there was no U-shaped developmental trend. The former claim is concerned with tasks in measuring metaphoric production, and the latter argument refers to children's metaphoric competence, i.e., the definition and nature of metaphor. Therefore, for further clarifying the issue of developmental trend in metaphoric production, the definition and nature of metaphor and the tasks used to measure metaphoric production are discussed in the following two sections.

II. The definition and nature of metaphor

A. Children's competence in metaphoric production and the definition of metaphor

Some research related to children's spontaneous speech indicated that almost as soon as they start to talk, children produce metaphoric-like utterances (e.g. Billow, 1981; Chukovsky, 1968; Piaget, 1962; Winner, et al., 1979). In Chukovsky's book, From Two To Five, children always have "enchanting" speech. For example, a three-year-old little girl muttered in her sleep: "Mom, cover my hind leg!"; another example is "Can't you see? I'm barefoot all over!".

Likewise, referring to Piaget's (1962) observation, his daughter Jacqueline (between age of 3:6 to 4:7) said of a caddis flying in a stream, "It's an insect in its cage." Finally, Winner, et al. (1979) found a 18-month-old child who called a toy car "a snake" while twisting it up his mother's arm. However, children's metaphoric-like utterances are interpreted with a disreputable standpoint. Although Chukovsky praised children's linguistic genius, he claimed that children's metaphors are nothing more than accidents or the results of errors of categorization (1968, p25); Furthermore, Piaget, pointed out that preschoolers' metaphors are the products of symbolic, imagistic type of thinking characteristic of the preoperational child. Preschoolers are incapable of producing real metaphors because they are incapable of forming the conceptual categories which metaphors are supposed to violate (Piaget, 1962). Accordingly, metaphoric competence is assumed to require complex linguistic and cognitive knowledge not required until age 10 or 11 (e.g. Asch & Nerlove, 1960; Piaget, 1974).

In recent years, since Piaget's views have come under heavy attack (e.g., Smith & Medin,1981; Sugarman, 1983), research in language and cognitive development has had a new concern for children's competences rather than incompetences (Marschark & Nall, 1985). Researchers have either become more careful in conducting the experimental tasks or more interested in the content of what children say and do and the extent to which this content might reflect their understanding of language and the world. In other words, research in children's language and cognitive development have been transferred from a formal or adult-centered to a child-centered approach.

Researchers are arguing that children's metaphoric competence appears much earlier than was traditionally thought, although they use different criteria for evaluating children's metaphor.

Referring to the literature attacking Piaget's view of the child's class-inclusion ability, Vosniadou (1987) argued that children's ability to form conceptual categories emerges much earlier than originally thought. Since his definition of metaphor is based both on perceptible similarity and on category-violation, in which class-inclusion ability is needed, Vosniadou contended that children's metaphoric competence should happen earlier than that which Piaget, Asch, and Nerlove claimed. In Vosniadou and Ortony's (1983) study, 3-year-old children can distinguish meaningful (i.e., literal and metaphorical) from meaningless (i.e., anomalous) statements, and by the age of 4 children know that some meaningful similarity statements compare items from the same conventional categories, while other meaningful similarity comparisons involve terms from different categories. Accordingly, Vosniadou claimed that children start with an undifferentiated notion of similarity that becomes differentiated into literal and nonliteral similarity at about age of 4. Children's real metaphoric competence appears around age of 4. This argument is consistent with Gardner's (1974) finding that even preschoolers can produce metaphors better than the level of chance in metaphoric matching tasks.

Marschark and Nall (1985), Winner (1979), Billow (1975), Verbrugge (1979) and Shanon (1988) all defined metaphor based on child-centered orientation and claimed that children before age of 4 can produce metaphors, although their definitions of metaphor are

somewhat different. Marschark and Nall's definition of metaphor highlights the metaphorical language in language use (communication). True metaphoric use of a linguistic unit depends on the presence of a ground that makes the utterance acceptable to the speaker while still being aware of the violation or believed violation of someone else's semantic categories (Marschark & Nall, 1985). For the purpose of judging children's metaphors, children's intentions to express or to violate the category are the substantial criteria. For the purpose of detecting children's intentions in using metaphoric language, Marschark and Nall suggested that children's metaphoric production should be identified with accompanying verbal commentary (e.g., explicit comment, laughter, or request for approval). Winner (1979), on the other hand, argued that metaphor is based on perceptible similarity and that children's metaphor should be identified with their intention for distinguishing the difference between overextension and metaphor. For the purpose of measuring children's intention in using metaphoric language, children have been asked to use an object's literal name in proximity close enough to show that they know the real label. Therefore, Winner considered children's metaphor as renaming. All of Billow (1981), Verbrugge (1979), and Shanon (1988) adopted an external observer's viewpoint to define metaphor; that is, the only criterion for judging the metaphor is perceptible similarity. Billow (1981), however, asked children for the old name of the metaphoric referent in order to determine the children's awareness and understanding of their own utterances. Verbrugge (1979, 1980), on the other hand, had the most liberal definition of metaphor, based on the realistic approach to knowledge.

The living system is organized to detect environmental structures without representations. For Verbrugge, the living system is developing an attunment to structure and thereby changing its potential relationship with environments. Meaning inheres in the relationship between a living system and its environment. Metaphoric process is a transitional phase in which there is a partial transformation of a topic's identity by a second identity. In this activated complex of dual identities, an unusual structural organization of the topic stands out in high relief. If attunment to this structure in the topic survives, there is a change in knowing. The metaphor can be across or within verbal and nonverbal (e.g., perception and action) domains based on perceptible similarity. Finally, Shanon (1988) explored the nature of representation and claimed that knowledge representations are products of cognitive activity but not the basis of it. Shanon argued that there exists no fixed literal meaning, that must precede any metaphor. Therefore, he also preferred the liberal definition.

Taken as a whole, in defining the metaphor, Vosniadou (1987) and Marschark and Nall (1985) all emphasized that real metaphoric production needs the producer to know that the conventional category is being violated. Both Winner (1979) and Billow (1981) required verbal accompaniment to make sure that children are aware of producing metaphors, although Winner was concerned more with the difference between overextension and metaphor. Verbrugge (1979, 1980) and Shanon (1988) were not concerned metaphor with assumptions regarding the speaker's knowledge or purported motivation. Rather, an external observer's point of view is taken, and any figurative

nonliteral usage of language is considered. Shanon, however, observed that there exist at least two different underlying processes in metaphoric production from a larger developmental perspective. The metaphoric production in the early stage is primitive in that it is not differentiated, and the distinction between the two semantic domains involved in the metaphor is neither defined nor conscious. By contrast, in the advanced stage of metaphorical expression the producer is cognizant of the metaphor's constituting a nonstandard form of speech and of its relating two distinct semantic domains.

In a way, Vosniadou (1987) and Marschark and Nall (1985) are right. People sometimes indeed violate their conventional categories while they are using metaphorical language. For example, writers create category-violation metaphors very often. Vosniadou, Marschark, and Nall's definition of metaphor, nevertheless, implicitly supported the two-stage model, which contradicts some empirical evidence (e.g., Glucksberg, Gildea, & Bookin, 1982; Ortony, et al., 1978). The two-stage model asserts that either literal meaning develops before nonliteral meaning or literal interpretation is attempted before the nonliteral interpretation. In terms of Vosniadou, Marschark and Nall's definition of metaphor, children should violate the conventional categories to produce metaphor. Thus, they should have literal language in mind first. In addition, since this definition implicitly supports the notion that simile is equivalent to metaphor, it also contradicts some empirical evidence (e.g., Verbrugge, 1980). Besides, inasmuch as adults produce metaphors without verbal commentary most of the time and also children laugh all the time, it is difficult to determine whether children's laughter comes with

their metaphors or not. Therefore, Marschark and Nall's (1985) suggestion of using verbal commentary to identify children's metaphors does not seem to be plausible.

Winner et al.'s distinction between overextension and renamings does not solve the problem of distinguishing literal from nonliteral utterances. On the one hand, some adults's metaphors are overextension with an awareness of the fact that a conventional category is being violated (Vosniadou, 1987); on the other hand, knowing names of an object is not equal to knowing the category of the object. Since there exists no fundamental representation, the concept of category cannot be formed until children can abstract the invariant representations from the members of a category. In other words, very young children have names for the individual object first. After they encounter a great number of individual objects, which shared some features, then children abstract the invariance into a category. Hence, even children's awareness of two names for an object does not necessarily mean that children know that they are violating the boundary of the conventional category. Therefore, it seems that before children can handle the concept of category, children are already able to produce metaphor, with or without awareness. Researchers have pointed out that children's early metalinguistic abilities (children's being aware of their language usage) differ from those which they acquire later, namely, adult metalinguistic abilities (e.g., Hakes, 1980). Accordingly, children's awareness of knowing two names for one object is not an appropriate index for their knowing category-violation. To the same point, the fact that Billow (1981) questioned children about the original

meaning of the metaphoric referent is redundant. In addition, given a different context, children could forget the adults' conventional meaning of the word. This may be the reason why, in Billow's (1981) study, children always answered with the metaphoric meaning and could not give the literal meaning of the object until asked several times.

Both Verbrugge's (1977, 1980) and Shanon's (1986) issues concerning knowledge representation seem to offer reasonable theoretical bases for metaphorical language, but they still cannot interpret the whole metaphoric phenomenon. First, Verbrugge's theory said nothing about the possibility of different metaphoric processes (Ortony, et al. 1978). Second, although Shanon pointed out that there are at least two kinds of processes for metaphoric production from a developmental perspective, he, however, did not give an alternative model for interpreting them. Third, not all adults' metaphors are advanced ones because sometimes even adults do not know that a conventional category has been violated, while they are producing metaphors (Ortony, et al., 1978).

B. The nature of metaphor

The foregoing discussion revealed that there are at least two kinds of metaphoric processes; that is, one in which the metaphor producers violate a conventional category (category-violation metaphor) or one in which they do not (undifferentiated metaphor). And children can produce the former one at about age of 4 but as young as age of 2, children can produce undifferentiated metaphors. This observation is correspondent to Gardner and Winner's (1986) suggestion that metaphor may be defined in either a strong or a weak

fashion. Unfortunately, none of discussed definitions or theories can explain the phenomenon completely. Hence, the nature of metaphor needs to be explored more.

Although they did not directly discuss the issue of metaphor, Campbell and Bickhard's (1986) model seems to be able to explain the whole picture. Bickhard (1978) and Campbell and Bickhard (1986), like Verbrugge (1980) and Shanon (1988), criticized the current approaches to knowledge and claimed that the living system is knowing the environment without the mediation of internalized models. Knowledge representations are the differentiating properties of any interactive system (Bickhard & Richie, 1983; Campbell & Bickhard, 1986). Accordingly, Bickhard and Campbell refuted the notion that literal language, which constitutes the philosophical basis for the standard representational view of mind, should develop or precede metaphorical language. Metaphor can be any figurative nonliteral usage of language or even of nonverbal modalities. In fact, since being a child, we have already tried to solve problems metaphorically. The examples have already been observed in Piaget's children's early cognitive development (Piaget, 1952). Bickhard and Campbell's viewpoint in the knowledge representation, like Verbrugge's (1979) and Shanon's (1988), did not reveal two different underlying processes for metaphoric production. Nevertheless, the knowing relationship Bickhard (1978) and Campbell and Bickhard (1986) claimed indeed explain the two underlying processes. Bickhard and Campbell argued that knowing is a successful goal-directed interactive process and that a relatively simple reflective iteration of the knowing relationship should be concerned with the nature of

the knowing relationship. They pointed out that the living system develops knowing levels through the processes of reflective abstraction. In knowing level one, the living system is capable of knowing something about an environment; and if it is interactively competent in that environment, then the knowing system itself will have properties that might themselves be known by a second knowing level of the same overall system through reflective abstraction. Likewise, the second level will in turn have knowable properties known by a third level. And so on. The attainment of these levels in development must follow a strict stage sequence, beginning with the lowest level, which knows only the environment, and ascending through the knowing levels in strict order. However, the knowing-level model does not define stages in terms of structures of the whole. A living system could be in different knowing levels across domains (different fields). Generally speaking, the reflective abstraction of major invariant representations for entering knowing level two is completed at about age of 4; and those for entering knowing level three usually appear to emerge from 9 to 11 years of age. Accordingly, people who are at knowing-level one in metaphoric production, produce undifferentiated metaphors through overextension or renaming because they are directly interacting with the environments and cannot reflectively abstract the invariant representations. Consequently, metaphoric phenomena are very natural for a living system's cognitive activity. Since people with knowing-level-two can reflectively abstract the properties of the first level, conventional categories can be formed. Moreover, since knowing-level two has emerged by about age of 4, it is very possible that children around that age can

exhibit metaphors by violating the boundary of conventional category (Vosniadou, 1987). That is, given that a metaphoric expression is needed (either by environmental demands or by children's own motivation), children now can abstract one or more similar features from different categories and produce metaphors.

In sum, according to the knowing-level model, any figurative language can be taken as metaphor, though there are two kinds of underlying processes. Vosniadou (1987) then fails to say that there is no U-shaped developmental trend in metaphoric production because he only accepted the category-violation metaphors as real metaphors.

III. Tasks for measuring metaphoric production

Clarifying the definition and nature of metaphor does not help much the problem of explaining the two kinds of developmental trends in metaphoric production. In considering the relationship between developmental trends and measuring tasks, researchers proposed a variety of issues. On the one hand, Marschark and Nall (1985) claimed that a relatively naturalistic or experimenter-prompted situation is likely to be a most accurate indicator of figurative skills than are forced-choice discrimination tasks, renaming, or proverb production tasks because the former methods do not remove figurative language from context, but rather places its elicitors entirely in a child's linguistic and cognitive intentions. Combining the evidence from deaf children's metaphoric production (Marschark & West, 1985), Marschark and Nall accepted that the developmental trend is a U-shaped curve in metaphoric production. Likewise, Gardner et al. (1975) criticized the fact that the force-choice tasks fail to illuminate the development

of the capacity to produce and perceive verbal figures of speech. They thus conducted the experiment with incomplete vignettes and found that the metaphoric production follows a U-shaped curve. This result is consistent with that of Billow's (1981) observation of children's spontaneous metaphorical language. Since different age trends are revealed by their tasks, Pollio and Pollio (1974) claimed that the relative decrease in the number of figures produced in the *composition* task over successive grades resulted from children's reluctance to take chances with either spelling, grammar, or word choice. Pollio and Pollio suggested that a more accurate way to assess developmental trends would be to have children "speak their compositions". Winner et al. (1980) did not find a literal stage in their study. They pointed out that the absence of evidence for a literal stage in their study suggests that adhering to the literal reference of words may be a motivational rather than a competence problem. Billow (1981) also contended that children have an increasing capacity to produce metaphor when called for by a task's demand.

Taken as a whole, given a relatively naturalistic condition, children's developmental trend in metaphoric production should be a U-shaped curve, but the declining part of the curve is caused by motivational rather than competence issues. If the task encourages or enforces subjects to produce metaphors, then elementary students will produce more metaphorical language than do preschoolers.

Logically, children's capacity to produce metaphor should increase with age because their linguistic and cognitive competence increase with age. Interpreting the declining part of the

developmental trend (literal stage) as a motivational issue sounds very reasonable. However, in Winner et al.'s (1980) study, children were encouraged to rename series of objects in all three tasks; only children in age of 3, however, had a relatively low performance in *subject enactive* and *perceptual renaming* tasks rather than in *experimenter enactive* tasks (see Figure 4). It seems that there is another factor involved in task-specificity. An additional possible reason is that the *subject enactive* and *perceptual renaming* are too difficult for 3-year-olds. Also the underlying causality is related to the children's knowing-level. If the tasks need at least knowing level two ability, children who haven't emerged the second level ability, of course, cannot perform the tasks well. If we refer back the Winner et al's (1980) tasks, it seems that only the *experimenter enactive* task offered the context for children's metaphoric production. Likewise, Gardner et al. (1975) asked children to produce metaphors with incomplete vignettes which also offered context benefits. Suffice it to say that in composition task (Pollio & Pollio, 1974) and spontaneous speech, context plays an important role. Context effects occur during the never-stopping interaction between the living system and its environments. Therefore, given that the context is provided, anyone in knowing-level one can produce metaphors; whereas in context-free tasks, children need to abstract the elements across their conventional categories to make up metaphors. Children need at least knowing-level two ability to respond to the latter tasks. Hence, we can predict that in using context-free tasks to measure children's metaphoric production, we should obtain a linearly increasing trend with development because

younger children who are still at knowing-level one can not do context-free tasks . The foregoing research seems to confound the effects of motivational and task difficulty factors together. One of the purposes of the present study, therefore, is to investigate whether the task difficulty is also a reason to cause an increasing linear developmental trend and whether or not the task difficulty is related to children's knowing level.

IV. The underlying causality for developmental U-shaped curve in metaphoric production

The foregoing discussion indicated that, given more naturalistic tasks, the developmental trend in metaphoric production will be a U-shaped curve. Although in both Gardner et al.'s (1975) and Billow's (1981) studies, there were no statistical significance in differences across the age groups, the U-shaped developmental trend has also been found in the development of hearing-impaired children's metaphoric expression (Marschark et al., 1986) and of children's drawing performances (Gardner & Wolf, 1979; Silverman, Winner & Gardner, 1976). In addition, the U-shaped curve is consistent with Silverman, Winner, and Gardner's finding that at the end of the "literal stage" (at around ten years), subjects can rapidly learn to produce acceptable figures of speech in the simile-completion task. The reason that some of the studies cannot achieve significance levels for the U-shaped curve may be because most of the studies plotted metaphoric production against age, which is only a surface variable, but which covaries with the true underlying processes of metaphoric production in development. This suggestion is consistent with Gardner

et al.'s (1975) finding that there is a large individual variation among the youngest children in producing metaphors. The possible underlying processes thus will be discussed as follows.

Gardner et al. (1978) stated that in the literal stage children are consolidating the literal meanings of words and the community definitions of categories and are reluctant to countenance any violations of these recent acquisitions. Matter and Davis (1975) contended that children's being corrected for their conceptual errors and children's getting their categories straight are the reasons for decrease of metaphoric production. Marschark and Nall (1985) argued that the literal stage is a function of an increased language repertoire and of regularizing the linguistic skills. Winner et al. (1980) claimed that enlargement of vocabulary capacity, increased motivation to follow rules, and conformity to one's peers are three reasons for the literal stage.

Taken together, the reasons accounting for the literal stage can be the error correction, motivation to obey rules, and enlargement of vocabulary capacity. In the midst of them, the error correction does not seem to be a plausible reason, inasmuch as young children are corrected in their misconcepts most of the time, but the correction is not always effective (e.g., Bohannon III & Stanowicz, 1988). The issue of enlargement in vocabulary capacity is plausible, since inexpressibility is a main reason to produce metaphor (Gerrig & Gibbs,Jr., 1988; Marschark & Nall, 1985; Ortony, 1975). However, it cannot explain the increase in preadolescents' amount of metaphorical language. The fact that children have motivation to obey rules in elementary schools has been observed. Since the literal stage of

metaphoric production begins around age of 4, the atmosphere of school should not be the cause for motivating children to obey rules. From the perspective of the knowing-level model, children in knowing-level one know the environment but cannot reflectively abstract the invariant representations for rules. Since children in knowing-level two have "rules" concept in mind, they hold only the literal meaning as the right meaning for a word and strictly obey the literal meaning. This issue can explain why children after about age 4 prefer the literal meaning in some of the metaphoric tasks (Gardner, et al., 1975; Pollio & Pickens, 1980). During further development, however, children reflectively abstract the second level's properties that rules are set by people and can be changed. Therefore, in knowing-level three, children convey more metaphorical expressions and appreciate metaphor's artistic significance.

In sum, children's vocabulary capacity and knowing level have been identified as the underlying causalities for the U-shaped developmental trend in metaphoric production. However, children enlarge their vocabulary capacity continuously. If the enlargement of vocabulary causes the decline of metaphoric production, how then can it also causes children's increase in metaphoric production after preadolescence (onward 10 or 11 years old). Notice that there are two kinds of metaphoric processes. The negative relationship between the vocabulary capacity should be observed only if all metaphoric production is of undifferentiated metaphors. From the knowing-level perspective, however, we may argue that beyond knowing-level one, children who have a larger vocabulary capacity will have more metaphoric production. At age of 10 or 11, children may have knowing-

level three ability so that they can produce category-violation metaphors. The more categories children have, the more metaphors they can produce. Beyond the knowing-level one, vocabulary capacity could be an index for the number of conceptual categories. Therefore, the other two purposes of the present study are to investigate if knowing-level is the true underlying causality for the U-shaped curve and if there is any interaction effect between knowing-level and the vocabulary capacity.

PROPOSED RESEARCH STUDY

Statement of the Problem and Hypothesis

The present study is concerned with the underlying causalities of the U-shaped developmental trend in metaphoric production and the causes which make up the linearly increasing trend.

Although age may predict the U-shaped developmental trend, it is supposed to be a covariate variable with the true underlying causality for metaphoric production in development. The knowing-level (Bickhard, 1978; Campbell & Bickhard, 1986), which should have a more powerful prediction of the U-shaped curve than does age, is considered to be the underlying causality for the U-shaped developmental trend. The vocabulary capacity is another variable related to the U-shaped developmental trend. The enlargement of vocabulary capacity can be used to explain the declining part of the U-shaped curve trend (Gerrig & Gibbs, Jr., 1988; Marschark & Nall, 1985; Winner, et al., 1980), but not to explain the re-increasing part of the curve. The present study argues that if all metaphoric production were undifferentiated, there could be a negative linear relationship between vocabulary capacity and metaphoric production. Otherwise, if the undifferentiated and category-violation metaphors are combined to indicate the metaphoric production, the knowing-level will be involved in the U-shaped developmental trend. According to the knowing-level model, at knowing-level one children produce

undifferentiated metaphors; therefore, the larger the vocabulary capacity, the lesser the metaphoric production. Beyond knowing-level one, the larger the vocabulary capacity, the larger the resource for abstracting similarities across different categories to make up metaphors. Nevertheless, children at knowing-level two tend to obey rules and are reluctant to produce metaphors, no matter how large a vocabulary capacity the children have. In addition, since the "inexpressibility" factor facilitates metaphoric production across the whole of life, at knowing-level two, the larger the vocabulary capacity, the lesser the metaphoric production. At knowing-level three children like to produce unusual language; therefore, the larger the vocabulary capacity, the larger the metaphoric production. Accordingly, there should be an interaction effect between the knowing-level and the vocabulary capacity on metaphoric production.

Given a task which encourages subjects to produce metaphors, the developmental trend in metaphoric production is a linearly increasing one (Billow, 1981; Winner et al., 1980). The task difficulty, which relates to the knowing-level, is considered to be confounded with the motivation variable in the linearly increasing trend. Given that the encouragement is provided in both easy and difficult tasks, there should be an interaction effect between children's knowing-level and task-difficulty on metaphoric production.

Specifically, seven hypotheses will be tested in the present study. The first two hypotheses are for prechecking the age effect in metaphoric production. The third and fourth hypotheses are to examine whether the knowing-level can predict the U-shaped developmental trend and also to determine if the knowing-level makes a unique

contribution to the U-shaped curve. The fifth hypothesis is related to the relationship between knowing-level and vocabulary capacity on metaphoric production. The sixth hypothesis seeks to ascertain if knowing-level and vocabulary capacity are the only two variables which explain the U-shaped developmental trend in metaphoric production. Finally, the seventh hypothesis explores the interaction relationship between knowing-level and task difficulty on metaphoric production.

Hypothesis 1: Given a low motivation task, the relationship between age and metaphoric production will not be linear so that a simple regression model using age to predict metaphoric production cannot fit the data, i.e., the model has no predictive power.

Hypothesis 2: Given a low motivation task, the relationship between age and metaphor production will be quadratic so that, if we regress metaphoric production on the squared age, the model will have significant predictive power.

Hypothesis 3: Given a low motivation task, knowing-level will have significant effects on metaphoric production because it is predicted that metaphor production will be higher in knowing-level one than in level two and that it will be lower in level two than in level three. The difference between level one and level three is not predicted by the present study specifically.

Hypothesis 4: Given a low motivation task, if the effects of age on metaphoric production are partialed out, the residual can still be predicted by the knowing-level. The difference of means of the residual variable among the three knowing-levels will have the same pattern as predicted in hypothesis 3.

Hypothesis 5: Given a low motivation task, knowing-level and vocabulary capacity will have an interaction effect on metaphoric production, i.e., the slopes for vocabulary in the first two knowing-levels will be negative and different from that of knowing-level three. The slopes for vocabulary in level three will be positive.

Hypothesis 6: Given a low motivation task, if the effects of knowing-level and the interaction effects of knowing-level and vocabulary capacity on metaphoric production are partialed out, will there still be any significant quadratic linear relationship between the residuals and age? This question is exploratory; no specific hypothesis will be made because no evidence indicated whether knowing-level and vocabulary capacity are the only two underlying causal factors for the U-shaped developmental trend in metaphoric production.

Hypothesis 7: Given a high motivation task, there will be an interactive effect of knowing-level and task difficulty on metaphoric production. In other words, the difference between knowing-level one and two in the easy task will be significantly different from the difference between knowing-level one and two in the difficult task.

Method

Subjects

Ninety children from middle-class families attending nursery and public schools in Austin, Texas will participate in the study. Children's ages ranging from 3 years 0 month to 14 years 11 month.

For balancing the number of children per possible knowing level, the numbers of children in each age level are not all equivalent. There are 15 children for each level of 3, 4, and 10 years of age, and 5 children for each of the remaining age levels. The children are all native English speakers without bilingual background. Within each age level, the numbers of boys and girls are almost equivalent.

Measurement instruments

A. Metaphoric production tasks: Three tasks which cross the variables of task difficulty and motivation will be used to measure children's metaphoric production. The easy task will refer to a task with contextual facilitation, whereas the difficult task is a task providing no context cues. The motivation task will refer to a task with instructions which will encourage children to produce metaphors.

Easy with low motivation condition -- Given a fanciful topic with some cued questions provided, children will be asked to tell a story out loud.

Easy with high motivation condition -- Given a fanciful topic with some cued questions provided, children will be asked to tell a story out loud with as many weird sentences as possible.

Difficult with high motivation condition -- Presented with either a objects or 2 words, children will be asked to verbally identify as many similarities between those two objects or terms as possible. Pollio and Pollio's (1974) comparison task will be used, although the instructions are changed slightly.

B. Knowing-level tasks : According to Campbell and Bickhard (1986), children at knowing level two reflectively abstract properties of level one representations, which permits certain logical inferences to be drawn; and at level three children reflectively abstract properties of level two representations, so that they could recognize the necessity of a level two logical principle and judge whether the conditions for applying the principle are fulfilled. Therefore, concerning children's ability in hierarchical classification, Campbell and Bickhard remarked that children at knowing level two can apply the class-inclusion principle to the classification task; and at level three children recognize that the class-inclusion principle must hold for any class-subclass relationship, regardless of additions to or subtractions from the subclasses. Since the classification of objects is a major invariance for children, the present study employs children's classification ability as the index of children's knowing level. As for the fact that Piaget's classification task is now under serious attack, Campbell (1986) claimed that Shipley's (1979) class-inclusion task in which the standard classification task is changed in wording could be appropriate for testing children's class-inclusion ability. In addition, children at knowing-level three are coming to know the explicit rules of class-inclusion; therefore, regardless of additions to or subtractions from the members of subclasses, the children will still hold for any class-subclass relationship. Markman's (1978) modification task thus will be employed to test children's knowing-level three ability. An example for each task is depicted as follows:

Knowing level two condition -- A set of objects made up of two coordinate classes (e.g. apples and oranges) will be in front of the child with a rough grouping of the subclasses. Children will be asked a following question: "Which is more: only the apples or all the fruit?"

Knowing level three condition -- Children are asked a question: "Could you make it so that there will be more apples than fruit?" After answering, the children will be asked "how" or "why not", depending on their answer.

C. Vocabulary capacity test: The *Peabody Picture Vocabulary Test -- Revised* (PPVT-R) "Form L" will be used to measure children's receptive vocabulary capacity. This test, which was published in 1981, consists of a series of 175 plates, each containing four pictures. As each plate is presented, the examiner provides a stimulus word orally; the examinee responds by pointing to or in some other way indicating the picture on the plate that best illustrates the meaning of the stimulus word. The PPVT-R is individually administrated and is applicable to a wide age range (2 years 6 months to 40 years). The administration time is unlimited. However, there are provisions for administration of only those items within the subject's critical range for age; therefore, administration time typically requires only 15-20 minutes. The reliability of the PPVT-R has been evaluated to establish internal consistency, alternate forms reliability, and consistency or stability over time (test-retest). For form L, the resulting coefficients of internal consistency range from .67 to .88 for children below age 19 and .82 for adult. The

coefficients of equivalence range from .73 to .91. Test-retest reliability with a time interval of 9 to 31 days range from .52 to .90 for raw scores and from .54 to 90 for standard scores. The validity evidence for PPVT-R is considered to support content, construct, and concurrent validity. Content validity is supported by selection of vocabulary items on the basis of vocabulary searches and cross-referencing with age/grade level referred vocabulary lists. Construct validity is supported by gradual increases over age in the percentage of subjects who responded correctly to an item and by so-called W-difficulty scores for items assigned through Rasch-Wright latent trait analysis. Coefficient of concurrence validity with the PPVT range from .53 to .87.

Procedure

Three experimenters who do not know the purposes of the present study will be trained by the present author to conduct the experimental tasks with children who are preschoolers, 1st to 4th, and 5th through 8th grades, respectively. The preschoolers' mothers will be invited to attend the metaphoric production tasks. Children will complete all tasks within two consecutive days and will be administrated individually in each task. Consequently, the whole study will take about sixteen days with the help of three experimenters. *Easy with low motivation* and *difficult with high motivation* tasks will be conducted on the first day. *Easy with high motivation, knowing-level-two* and *-three* tasks , and the *PPVT-R* test will be conducted on the second day. The whole experimental procedure will be video and audio taped. For holding the children's attention,

the instructions for preschoolers and public school students will be slightly different.

On the first day

The experiments will take place in a quiet room in the children's schools. In *Easy with low motivation* task which takes about 30 to 45 minutes, preschoolers will be presented with five different toys concerning life in outer space and told with the following instructions:"We are going to play a game. Look here! This is a new friend who just came from outer space (The experimenter is holding up ET). Do you know what outer space is? It is a place filled with all kinds of new stuff. Would you play with your new friend, and then tell me what you think about your new friend? Don't forget, you will tell a story about your new friend's life in his country to your mother later on." While playing, the child is cued with some questions such as: "Where does your friend live?", "What does the place look like, smell like, feel like?", and "What is your friend and what are people doing in his country?". After a half-hour period, the child's mother will be invited into the room. The child will be asked to tell the story to his/her mother. On the other hand, children in the public schools will invited individually to a noiseless room in their schools. Five different toys will be presented to the child here also. The child will be told to imagine that he/she was just finding out that a new kid in his/her classroom came from outer space. The child then will be asked to spend 15 minutes to think about the place their friend lives, to think about what the place looks like, smells like, feels like; and to think about what the people do there; and to think about anything in that

place which may be interesting to the child. After this warm-up activity, the child will be asked to tell a story about his/her new friend's life in outer space.

After the *Easy with low motivation* task, the child will be invited to play another game -- the *difficult with high motivation* task. The preschooler will be presented with three pairs of toys and asked to provide as many similarities as possible. He/she is told, for example, "This is a box and this is a can. Can you tell me anything which is the same between this box and this can. For example, they both hold things." The public student will be presented with three word pairs instead of three pairs of objects and asked to provide as many similarities as possible. The time for this task is about 15 to 20 minutes.

<u>On the second day</u>

The child will be invited to take part in the *Easy with high motivation* task, which takes about 30 to 45 minutes. He/She again will be asked to tell a fanciful story, this time on another topic, "One day I lost my way home." The procedure for this task for both the preschooler and public school student is the same as in the *Easy with low motivation* task except for the fact that the child is encouraged to use as many weird words and sentences as possible. The cued questions for the present topic include: "Where are you?", "Who do you meet?", "What do you see?", and "What can you do, among others?".

After the *Easy with high motivation* task, the child will be told to play another game -- *Knowing-level* tasks. A trial consists of placing a set of objects made up of two coordinate classes in front

of the child. Six sets of objects will be used: blocks (red and white Lego blocks of the same shape and size), marbles (large and small glass marbles), sticks (long and short wooden dowels), animals (small plastic lions and giraffes), fruit (plastic lemons and oranges), and children (boy and girl dolls). The larger subset will contain five objects; the smaller subset will contain two fewer. The exact number of objects, as well as which class will be named first, the subclass or the superordinate class, varied at random from trial to trial. The child then will be asked, for example, "Which is more: only the lions or all the animals?" The child's answers will be recorded. If the child answer correctly beyond the chance level (at least four out of six trials), the child will be identified as a knowing-level-two child. This session takes about 10 to 15 minutes. The knowing-level-two child will then be asked, for example, "Could you make it so that there will be more lions than animals?" After answering the children will be asked " how" or "why not", depending on their answer. The answers will be recorded.

After *Knowing-level* tasks, children will be asked to do *PPTV-R*. On one hand, the child under 8 years of age will be told by experimenter: "I want to play a picture game with you (Turn to example A). See all the pictures on this page. I will say a word, then I want you to put your finger on the picture of the word I have said. Let us try one...." On the other hand, the child of 8 years of age and above is told: "I have some pictures to show you. See, there are four pictures on this page. Each of them is numbered. I will say a word, then I want you to tell me the number of the picture which

best tells me the meaning of the word. Let us try one...." The administration of *PPVT-R* takes about 15 to 20 minutes.

Treatment of the Data

Children's metaphoric production: Since there are no reasonable criteria for distinguishing between frozen and novel metaphors (Pollio & Pickens, 1980), the present study accepts any figurative language as metaphors based on the viewpoint of trained judges. Basically, the procedure for counting children's metaphoric production is based on Barlow, Kerlin, and Pollio's (1971) rating technique designed to identify figurative language in psychotherapy protocols. Before judging children's metaphoric production, three raters need to be trained. They are trained first to recognize 15 different types of figurative usages and then are asked to rate independently four different prose passages. The raters are told that, since some of the child's metaphors may have become conventional language for him/her, the raters might consider that some language with metaphoric form might not be metaphors any more for the certain age child. After each of four passages is rated, the judges meet to talk about their ratings and to iron out differences. Once training is completed, and all raters feel confident that they can agree on the passages at least 80% of the time, they are then given the video and audio tapes to rate the child's metaphoric production. Raters' judgments are tallied on the basis of the following coding scheme:

3 + 0: All three raters independently judged this instance as figurative.

2 + 1: Two of the three raters independently judged this instance as figurative and that during the group discussion the third rater agreed.

1 + 2: Only one of the raters independently judged the instance as figurative but that after a group discussion the other two raters agreed.

2 - 1: Two raters independently chose an instance as figurative but the third judge after discussion did not agree.

1 - 2: One rater independently chose an instance as figurative but the other two raters disagreed even after discussion.

Only the instances rated as 1 + 2 or better will be counted as instances of metaphor for any task. All raw scores are converted to proportions,i.e., the number of figures over the number of words times 100. The reliability of judgments for each age level and each task will be computed.

Children's knowing-level: If children cannot correctly answer at least four trials out of six (beyond the chance level) in *Knowing-level-two* task, they are identified as knowing-level-one children. Otherwise, they are identified as knowing-level-two children. If children can correctly answer at least four trials out of six (beyond the chance level) and give plausible reasons for the how-question in *knowing-level-three* task, they are identified as knowing-level-three children. Examples for the plausible reasons would be: "I can't do it. It can't be done. If you kept on adding small marbles, you'd keep on adding marbles too," and "Lemons are fruit, and the only thing you can do is get more fruit than lemons."

Children's vocabulary capacity: The total raw scores children obtain from the *PPVT-R* are the indices of their vocabulary capacity. Since *PPVT-R* only tests the child's receptive vocabulary, the present study employs the number of "type" in the children's told stories as the index of children's expressive vocabulary. The "type" is a particular word counted just once, no matter how often it occurs in running text. This idea is different from that of Pollio and Pollio (1974). In their study, the length of the composition is a kind of the child's language ability. Further, the longer the composition, the more the metaphoric production.

Anticipated Results

For each hypothesis, the following analysis steps will be carried out, and anticipated results will be depicted.

Hypothesis 1: A simple regression model using age to predict metaphoric production will be

$$Y = \beta_0 + \beta_1 A + E$$

where Y is the amount of metaphoric production; β_0, β_1 are parameters to be estimated; A is age; and E is error. Since the present study predicts that, given the low motivation task, the linear trend has no predictive power, the F-test will not be significant. In other words, there is no linear relationship between age and metaphoric production.

Hypothesis 2: A linear model using age to predict metaphoric production and depicting a quadratic trend will be

$$Y = \beta_0 + \beta_1 A + \beta_2 A^2 + E$$

where Y is the amount of metaphoric production; β_0, β_1, β_2 are parameters to be estimated; A is age; and E is error. Since the present hypothesis predicts that given the low motivation task, the quadratic trend fits the data better, the F-test will be significant and R^2 in this model will be larger than that in the previous one. The R^2 difference can also be tested and is predicted to be significant.

Hypothesis 3: A linear model using the knowing-level to predict metaphoric production will be

$$Y = \beta_1 + \beta_2 K_2 + \beta_3 K_3 + E$$

where Y is the amount of metaphoric production; β_1, β_2, β_3 are parameters to be estimated; K_2 is a dummy variable where a person has a value of one if he is at knowing-level two, otherwise, a value of o; K_3 is a dummy variable where a person has a value of one if he is in knowing-level three, otherwise, a value of 0; if a person is at knowing-level one, he will have a value of 0 both in K_2 and K_3; and E is error. Since the present hypothesis predicts that, in a low motivation task, the knowing-level will have significant effects on metaphoric production, the F-test for the whole model will be significant. And since metaphoric production is predicted to be higher in knowing-level one than in knowing-level two, T-test for B_2 will be significant, i.e., $\beta_2 < 0$. Further, the metaphoric production is predicted lower in knowing-level two than in knowing-level three; therefore, F-test for $\beta_3 - \beta_2$ will be significant, i.e., $\beta_3 - \beta_2 > 0$.

Hypothesis 4: Given a low motivation task, if the effect of age on metaphoric production is partialed out, the residual can still

be predicted by the knowing-level and the difference of means of the residual variable among the three knowing-levels will have the same pattern as predicted in hypothesis 3. The linear model for testing the present hypothesis is

$$YR = \beta_1 + \beta_2 K_2 + \beta_3 K_3 + E$$

where YR is the residual of metaphoric production when the effects of age have been partialed out; β_1, β_2, β_3 are parameters to be estimated; K_2 is knowing-level two; K_3 is knowing-level three; E is error. The results will be: 1) F-test for the whole model will be significant; 2) T-test for β_2 will be significant; $\beta_2 < 0$; and 3) F-test for $\beta_3 - \beta_2$ will be significant; $\beta_3 - \beta_2 > 0$.

Hypothesis 5: A linear model analysis is used to test the interaction between the knowing-level and the vocabulary capacity. The linear model is:

$$Y = \beta_1 + \beta_2 K_2 + \beta_3 K_3 + \beta_4 V + \beta_5 K_2 V + \beta_6 K_3 V + E,$$

where Y is the amount of metaphoric production; β_1, β_2, β_3, β_4, β_5, & β_6 are parameters to be estimated; K_2 is knowing-level two; K_3 is knowing-level three; V is vocabulary capacity; and E is error. The hypothesis predicts that, given a low motivational task, at knowing-level one and two, the more vocabulary, the lesser metaphoric production. And at knowing-level three, the more vocabulary, the more metaphoric production. Accordingly, the direction of slopes for each level can be predicted. At knowing-level one and two, increasing vocabulary capacity will decrease metaphoric production. The slopes, $\beta 4$ for vocabulary capacity at knowing-level one, and $\beta 4 + \beta 5$ for vocabulary capacity at knowing-level two, should be significantly less than zero. At knowing-level three, increasing vocabulary

capacity will increase the metaphoric production. The slope for knowing-level three, $\beta_4 + \beta_6$, should be significantly greater than zero. The graph of the three slopes for vocabulary capacity at different knowing-levels is depicted in Figure 6. In order to check whether the interaction effect still holds when active instead of passive words are counted as the index of vocabulary capacity, the whole analysis will be repeated again with children's expressive vocabulary capacity.

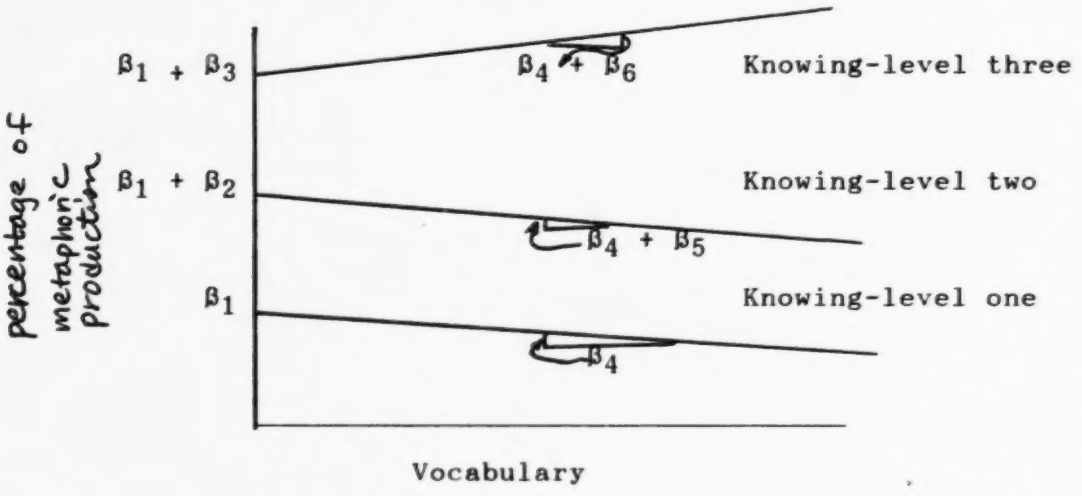


Figure 6: Three slopes for vocabulary capacity at each knowing-level on metaphoric production.

Hypothesis 6: The linear model analysis will be used. After partialing out the effects of knowing-level and vocabulary capacity, the residual metaphoric production predicted by age is

$$Y - \hat{Y} = \beta_0 + \beta_1 A + \beta_2 A^2 + E$$

where $\hat{Y}$ is Y - E in the model described in Hypothesis 5. In a low motivation task, if vocabulary capacity and knowing-level are the only two variables to predict the U-shaped developmental trend, the

F-test in the model will not be significant. To the contrary, if the F-test is significant it implies that, besides the vocabulary capacity and knowing-level, there are still other factors which contribute to the U-shaped curve in metaphoric production.

Hypothesis 7: Planned comparison will be used to test this hypothesis. The six numbers in cells are described in Table 1. Since children in knowing-level one should be able to perform the easy task but not the difficult task well, there should be a significant difference between the increased amount of metaphor production from knowing-level one to level two for the easy and difficult task. In terms of Table 1, the predicted interaction effects can be expressed thus as $a_5 - a_4 > a_2 - a_1$.

		KNOWING-LEVEL		
		1	2	3
TASK	easy	a_1	a_2	a_3
	diff.	a_4	a_5	a_6

Table 1. 3 x 2 ANOVA table with knowing-level and vocabulary capacity.

Discussion

For the purpose of integrating the empirical and theoretical controversies in the developmental trends in metaphoric production, Bickhard (1978) and Campbell and Bickhard's (1986) knowing-level model is employed in the present study. The knowing-level is considered a causal variable for the U-shaped trend in metaphoric production and a variable which interacts with vocabulary capacity on metaphoric production in the U-shaped curve. In addition, the knowing-level is related to the task difficulty, and an interaction effect can be obtained between task difficulty and knowing-level on metaphoric production. Since no previous study explores the relationship between knowing-level and metaphoric production, some of the possible factors which may influence the prediction of the hypotheses in the present study will be discussed. Furthermore, the knowing-level model is considered to be more viable for explaining the humans' cognitive and language activities. Some theoretical and practical implications of the present study thus will be remarked upon and some further studies are suggested.

The criteria for judging novel and frozen metaphor

Since there are no distinct boundaries between literal and metaphorical language (Rumelhart, 1979; Sadock, 1979) and since frozen metaphors generally function as regular vocabulary items (Pollio & Pollio, 1974), the criteria for identifying the novel or frozen metaphor for one's language usage are difficult to set. What may be frozen figures for adults may be still novel for children. In

Gardner et al.'s (1975), Pollio and Pollio's (1974), and Pollio and Pickens' (1980) studies, all the authors used adults' viewpoints to decide if subjects' metaphoric production was frozen or novel. Pollio and Pickens (1980) have found that this method may cause the artificial difference in developmental trends in novel and frozen metaphoric production. The present study does not offer an explicit criterion for decomposing frozen and novel metaphors. However, a proctor will instruct the raters that at a certain age, what are so-called frozen metaphors may still be novel for the producer. What can be judged as metaphor thus depends on the compromise among the raters. However, it is not to say that all novel metaphors for an individual can be correctly identified in the present study. A better method for encoding the individual's novel and frozen metaphors needs to be developed. Perhaps a norm for frozen metaphors in each age level needs to be built.

Correlation between knowing-level and age

The present study argues that knowing-level is the underlying causality for the U-shaped curve and that age is a covariate with knowing-level. Therefore, whether age has predictive power on the U-shaped curve or not depends on the correlation between knowing-level and age in the present sample. In other words, if there is a high correlation between age and knowing-level in the present sample, there would be a quadratic trend when we plot metaphoric production against age, and vice versa. Consequently, the second hypothesis may not hold if age will not covariate with knowing-level strongly. The relationship between age and metaphoric production may be sample-specific.

Index of vocabulary capacity

There are two aspects of an individual's vocabulary knowledge, i.e., "breadth" and "depth" of word knowledge (Anderson & Freebody, 1981). The "breadth" aspect of word knowledge refers to the number of words for which the person knows at least some of the significant aspects of meaning; and the "depth" aspect of word knowledge denotes the quality of word understanding. To be sure, both aspects of an individual's word knowledge can influence one's metaphoric usage. In the present study, the interaction between vocabulary capacity and knowing-level has been explored by employing both children's receptive and expressive vocabulary capacity, which only considers children's "breadth" aspect of word knowledge. Consequently, the imprecise index of vocabulary capacity could lessen the prediction on hypotheses 5 and 6.

Motivation and task difficulty

The present study claims that most tasks used in measuring metaphoric production with a linearly increasing trend confound the effects of motivation with the effects of task difficulty. Since the difficult task is always a high motivation task (enforcing or encouraging subjects to produce metaphorical language), the present study can only keep the "motivation" variable constant, and examine the interaction effect between knowing-level and task difficulty. Hence, the effect of motivation on a linearly increasing trend is not tested directly. This is another limitation of the present study.

U-shaped developmental trend and cross-cultural study

Since the knowing-level model is a model for explaining the nature of knowing of the living system, the principles derived from

this model should be universal. Hence, in a further study, a cross-cultural design may be employed. We might anticipate that, across the three knowing-levels, the U-shaped developmental curve in metaphoric production could be found in non-western culture.

U-shaped developmental trend in related creative fields

The knowing-level model affirms that the appearance of the literal stage in the child's metaphoric production takes place because, at knowing-level two, the child has abstracted the linguistic regularity and tends to obey rules. At about preadolescence, the child with knowing-level three has understood that rules can be changed, and that violating rules in some way has aesthetic value. Accordingly, the U-shaped developmental trend can occur in other fields, especially in other creative activities. Unfortunately, those fields cannot be explored by the present study. However, Gardner and Wolf (1979) and Silverman, Winner, and Gardner (1976) have found that there is a U-shaped developmental trend in the child's drawing performance. Similarly, Brown and Thouless (1965) and Looft and Bartz (1969) found that in early adulthood people produce a great deal of animistic usage. Since some of the specific fields are not major fields of a living system,i.e., not everyone makes contact with these fields right after birth, the U-shaped curve in those fields might appear late. Likewise, for the children who are deficient in some major fields, the U-shaped developmental trend in those fields may appear later than that in typically developing children (Marschark et al., 1986). Further empirical studies are suggested to investigate the U-shaped developmental curve in other

creative fields and in subjects who are deficient in some major fields.

Knowing-level two and metalinguistic abilities

According to the knowing-level model, children produce category-violation metaphors because, at knowing-level two they are capable of reflectively abstracting the properties of language across categories. This claim is similar to the issue of children's metalinguistic abilities (e.g., Cazden, 1975; Hakes, 1980). Hakes (1980) found that children during age 4 to 8 can demonstrate metalinguistic abilities and children's metalinguistic abilities all involve controlled processing of a differing sorts from the more automatic processing characteristic of comprehension and production. That is, metalinguistic performances require reflection upon one or another aspect of language *per se*. In addition, Hakes argued that the metalinguistic abilities during these years are all manifestations of a single underlying development. The present study may suggest that the change from knowing-level one to two could be the underlying developmental process for children's metalinguistic abilities. The relationship between knowing-level two and metalinguistic abilities needs to be explored in further studies in regard to the relationship between linguistic and cognitive development.

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